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CLAIMS

1. A feed material processing apparatus comprising:

a chamber having a substantially circular horizontal cross sectional shape;

at least one inlet in flow communication to an upper region of the chamber;

a single rotor having a substantially circular gross cross sectional shape located within the chamber that is rotatable at speeds of between about 200 km/hr and about 1200 km/hr about a substantially vertical axis by a rotation drive, wherein at least one vertically oriented feature or row of features located laterally on the rotor promotes a circulatory flow of feed material and/or gas within the chamber;

at least one outlet in flow communication from a lower region of the chamber.

2. The apparatus according to claim 1 wherein the rotor is substantially cylindrical in gross shape.

3. The apparatus according to claim 1 wherein diameter of the chamber narrows towards a base thereof.

4. The apparatus according to claim 3 wherein said narrowing diameter results from angled side walls of said chamber.

5. The apparatus according to claim 4 wherein the sides of said rotor are angled.

6. The apparatus according to any one of claims 1 to 5 wherein a region of narrowed diameter is provided within the chamber towards the base thereof.

7. The apparatus according to claim 6 wherein the said region of narrowed diameter results from presence of one or more screens or ledges within said chamber.

8. The apparatus according to any one of claims 1 to 7 wherein said chamber comprises a substantially flat roof.

9. The apparatus according to any one of claims 1 to 7 wherein said chamber

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comprises a domed roof.

10. The apparatus according to any one of claims 1 to 9 wherein an upper edge of said rotor and/or said feature/s located laterally on said rotor is/are bevelled.

11. The apparatus according to any one of claims 1 to 10 wherein an upper edge of said rotor and/or of said features located laterally on said rotor is/are formed from or coated with wear resistant material.

12. The apparatus according to claim 11 wherein said wear resistant material is selected from hardened steel, carbon tungsten, zirconia and diamond.

13. The apparatus according to any one of claims 1 to 5 wherein diameter of said chamber increases at a base thereof.

14. The apparatus according to any one of claims 1 to 13 wherein one or more surfaces of said chamber, said rotor and/or said features located laterally on said rotor is/are coated with non-stick material.

15. The apparatus according to any one of claims 1 to 13 wherein an upper surface of said rotor is coated with a non-stick material.

16. The apparatus according to either claim 14 or claim 15 wherein the non-stick material is selected from non-stick polymer, non-stick titanium compound or Teflon™.

17. The apparatus according to any one of claims 1 to 16 comprising outlets at varying vertical positions of the chamber to allow removal from the chamber of feed material particles of graded size or mass.

18. The apparatus according to any one of claims 1 to 17 comprising at least one recirculation circuit between an outlet and an inlet to allow return of feed material from a lower region to an upper region of the chamber.

19. The apparatus according to any one of claims 1 to 18 wherein the at least one inlet

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comprises a closure and/or a variable aperture.

20. The apparatus according to any one of claims 1 to 19 wherein the at least one outlet comprises a closure and/or a variable aperture.

21. The apparatus according to any one of claims 1 to 20 comprising a ledge, shelf or screen within the chamber adjacent to the at least one outlet to direct feed material particles to the outlet and/or to promote grading of feed material particle size or mass.

22. The apparatus according to any one of claims 1 to 21 comprising a ledge or shelf within the chamber in association with the at least one inlet, onto which feed material can initially be directed.

23. The apparatus according to claim 1 wherein the feature located laterally on the rotor comprises at least one projection and/or depression.

24. The apparatus according to claim 23 wherein the at least one depression comprises at least one substantially vertical groove or trough.

25. The apparatus according to claim 23 wherein the at least one projection comprises at least one substantially vertical row of spikes and nodules.

26. The apparatus according to claim 23 wherein the at least one projection comprises at least one substantially vertical bar or blade.

27. The apparatus according to any one of claims 1 to 26 wherein distance between said rotor and side walls of said chamber is substantially consistent along said rotor.

28. The apparatus according to any one of claims 1 to 26 wherein distance between said rotor and side walls of said chamber decreases towards a base of said chamber.

29. The apparatus according to any one of claims 1 to 28 comprising at least one projection on an upper and/or lower surface of the rotor.

30. The apparatus according to claim 29 wherein said at least one projection on an upper and/or lower surface of the rotor is at least one spike and/or nodule.

31. The apparatus according to claim 30 wherein a plurality of spikes and/or nodules form at least one row radiating from a centre to a periphery of the upper and/or lower surface.

32. The apparatus according to any one of claims 1 to 31 wherein the rotation drive comprises a motor driveably engaged to a drive shaft that is in turn driveably engaged to the rotor through a substantially vertical central axis thereof.

33. The apparatus according to claim 32 comprising a positive pressure scroll within the chamber in association with the drive shaft to substantially prevent ingress of feed material to drive shaft associated bearings.

34. The apparatus according to either claim 32 or claim 33 wherein the motor is a variable speed electric motor.

35. The apparatus according to any one of claims 31 to 34 wherein the drive shaft enters the chamber from above.

36. The apparatus according to any one of claims 31 to 34 wherein the drive shaft enters the chamber from below.

37. The apparatus according to claim 36 wherein an inlet is located substantially centrally within a roof of the chamber.

38. The apparatus according to claim 36 wherein an upper surface of the rotor comprises a substantially centrally located recess for receiving feed material from the substantially centrally located inlet.

39. The apparatus according to any one of claims 1 to 38 wherein at least one outlet is in flow communication with one or more of a cyclonic extractor, a filter, a bag house, a gas collector and a condenser.

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40. The apparatus according to any one of claims 1 to 39 comprising thermal insulation to minimise or reduce heat loss during operation or a heat exchanger to control processing temperature.

41. The apparatus according to any one of claims 1 to 40 wherein the at least one inlet is configured to allow control of gases entering the chamber.

42. A milling apparatus comprising:

a chamber having a substantially circular horizontal cross sectional shape;

at least one inlet in flow communication to an upper region of the chamber, wherein at least one said inlet is located substantially centrally within a roof of the chamber;

a single rotor having a substantially circular gross cross sectional shape located within the chamber that is rotatable at speeds of between about 200 km/hr and about 1200 km/hr about a substantially vertical axis by a rotation drive comprising a motor driveably engaged to a drive shaft that is in turn driveably engaged to the rotor, wherein the drive shaft enters the chamber from below;

at least one vertically oriented feature or row of features located laterally on the rotor to promote a circulatory flow of feed material and/or gas within the chamber;

at least one outlet in flow communication from a lower region of the chamber.

43. A method of processing a feed material comprising:

introducing the feed material into a chamber having a substantially circular gross cross sectional shape of a processing apparatus through at least one inlet that is in flow communication to an upper region of the chamber;

imparting a circulatory flow on the feed material within the chamber by rotation at speeds of between about 200 km/hr and about 1200 km/hr about a substantially vertical axis of a single rotor having at least one vertically oriented feature or row of features located laterally thereon that promote circulatory flow;

recovering processed feed materials through at least one outlet that is in

flow communication from a lower region of the chamber;

wherein the feed material is processed by undergoing at least one of milling, mixing, blending, separation, drying and sterilisation.

44. A method according to either claim 42 or claim 43 wherein the feed material comprises one or more of plant, animal or microorganism derived feed materials, waste materials, water requiring purification or solid material that is to be milled to produce a granulated or powdered product.

45. A method of producing a powdered, granulated and/or dried food, food ingredient or nutritional supplement comprising:

introducing a plant, animal or microorganism derived feed material into a chamber having a substantially circular gross cross sectional shape of a processing apparatus through at least one inlet that is in flow communication to an upper region of the chamber;

imparting a circulatory flow on the feed material within the chamber by rotation at speeds of between about 200 km/hr and about 1200 km/hr about a substantially vertical axis of a single rotor having at least one vertically oriented feature or row of features located laterally thereon that promote circulatory flow;

recovering a powdered, granulated or dried food, food ingredient or nutritional supplement through at least one outlet that is in flow communication from a lower region of the chamber.

46. The method according to claim 45 wherein the plant derived feed material comprises sap, wood, plant, leaves, seeds, roots, shoots, stems, branches, bark, fruit, nuts and/or components thereof.

47. The method according to claim 45 wherein the animal derived feed material comprises meat, offal, eggs, milk, blood, skin, hair, fur, shell and/or components thereof.

48. The method according to claim 45 wherein the microorganism derived feed material comprises bacteria or fungi, components thereof or products therefrom.

49. The method according to claim 45 wherein the plant, animal or microorganism derived feed material comprises one or more by-products from food or beverage processing or production.

50. The process according to claim 49 wherein the by-products are from fermentation, brewing, culturing, baking, cooking or food ingredient processing.

51. A method of processing a waste material comprising:

introducing a waste material into a chamber having a substantially circular gross cross sectional shape of a processing apparatus through at least one inlet that is in flow communication to an upper region of the chamber;

imparting a circulatory flow on the waste material within the chamber by rotation at speeds of between about 200 km/hr and about 1200 km/hr about a substantially vertical axis of a single rotor having at least one vertically oriented feature or row of features located laterally thereon that promote circulatory flow;

recovering processed waste material through at least one outlet that is in flow communication from a lower region of the chamber;

wherein the waste material is processed by undergoing at least one of milling, mixing, blending, separation, drying and sterilisation.

52. The method according to claim 51 wherein the waste material comprises treated or untreated sewerage, animal manure, paper, glass, offal, animal skin, shell, fur, hair or feathers, cementatious material, rock, bitumen, hydrocarbon material, plastics, polymers, oils or fats or a by-product from mineral processing or extraction.

53. A method for water purification comprising:

introducing water to be purified into a chamber having a substantially circular gross cross sectional shape of a processing apparatus through at least one inlet that is in flow communication to an upper region of the chamber;

imparting a circulatory flow on the water to be purified within the chamber by rotation at speeds of between about 200 km/hr and about 1200 km/hr about a substantially vertical axis of a single rotor having at least one vertically oriented

feature or row of features located laterally thereon that promote circulatory flow;

separately recovering impurities and substantially purified water that have exited the chamber through at least one outlet that is flow communication from a lower region of the chamber.

54. The method according to claim 53 wherein the water to be purified is sea water.

55. A method of milling a solid feed material to produce a granulated or powdered material, comprising:

introducing the feed material into a chamber having a substantially circular gross cross sectional shape of a processing apparatus through at least one inlet that is in flow communication to an upper region of the chamber;

imparting a circulatory flow on the feed material within the chamber by rotation at speeds of between about 200 km/hr and about 1200 km/hr about a substantially vertical axis of a single rotor having at least one vertically oriented feature or row of features located laterally thereon that promote circulatory flow;

recovering a granulated or powdered material through at least one outlet that is in flow communication from a lower region of the chamber.

56. The method according to claim 55 wherein the solid feed material is glass, wood, grain, husks or chaff, concrete, rock, bitumen, plastics, polymer material or minerals.